



NORTH DAKOTA GEOLOGICAL SURVEY  
UNIVERSITY, N. DAK.

Wi  
U84  
QE  
179  
.A3  
Perin  
Geol

FOURTH BIENNIAL REPORT  
OF THE  
COMMISSIONERS  
OF THE

**Geological and Natural History Survey**

Covering the period from  
July 1, 1902, to June 30, 1904.



MADISON, WIS.  
DEMOCRAT PRINTING CO., STATE PRINTER.  
1904.



## STATE OF WISCONSIN.

---

# GEOLOGICAL AND NATURAL HISTORY SURVEY

---

### BOARD OF COMMISSIONERS, 1904.

ROBERT M. LAFOLLETTE,

*Governor of the State.*

CHARLES R. VAN HISE, PRESIDENT,

*President of the University of Wisconsin.*

CHARLES P. CARY, VICE PRESIDENT,

*State Superintendent of Public Instruction.*

CALVERT SPENSLEY,

*President of the Commissioners of Fisheries.*

JOHN J. DAVIS, SECRETARY,

*President of the Wisconsin Academy of Sciences  
Arts, and Letters.*

---

### STAFF OF THE SURVEY.

E. A. BIRGE, DIRECTOR AND SUPERINTENDENT.

T. C. CHAMBERLIN, CONSULTING GEOLOGIST.

*Pleistocene Geology.*

S. WEIDMAN, GEOLOGIST.

*In charge of the Geology of Central Wisconsin,  
and Baraboo District.*

U. S. GRANT, GEOLOGIST.

*In charge of Geology of Southwestern Wisconsin.*

HEINRICH RIES, GEOLOGIST.

*In charge of Report on Clays.*

L. S. SMITH,

*In charge of Hydrography.*

W811

# FOURTH BIENNIAL REPORT

OF THE

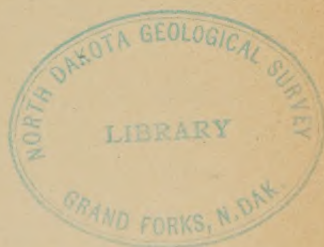
## COMMISSIONERS

OF THE

# Geological and Natural History Survey

Covering the period from  
July 1, 1902, to June 30, 1904.

**NORTH DAKOTA GEOLOGICAL SURVEY**  
**UNIVERSITY, N. DAK.**



MADISON, WIS.  
DEMOCRAT PRINTING CO., STATE PRINTER.  
1904.





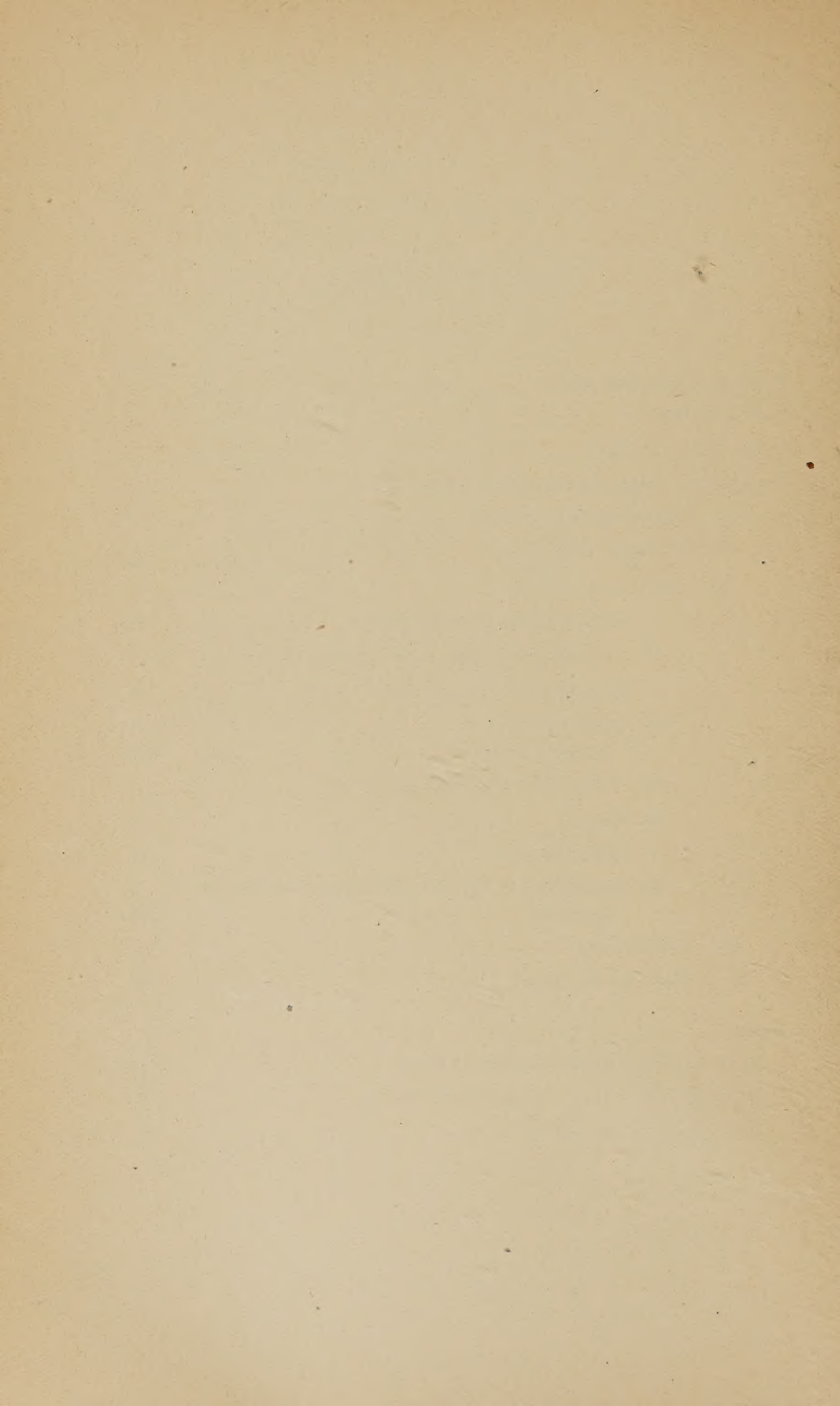
## TABLE OF CONTENTS.

---

	Page
Board of Commissioners.....	5
Staff of Survey.....	6
Letter of Transmittal.....	7
Report of the Superintendent of the Survey.....	9
I. Personnel of the Survey.....	10
II. Financial Statement.....	12
III. Work of the Survey.....	13
A. Survey of the Baraboo District .....	14
B. Investigation of the Lead and Zinc District .....	16
C. Investigation of the Clays .....	19
D. Areal Geology .....	22
Report on Soils.....	24
E. Aid to Forestry Investigation.....	24
F. Peat.....	25
G. Lake Biology .....	25
H. State Mineral Exhibit, Louisiana Purchase Ex- position.....	26
IV Publications .....	28
V. Plans for the future.....	29

### Appendix:

Financial report from Secretary of State .....	33-36
Statutes of Wisconsin relating to the Survey .....	37
Publications of the Survey.....	40



STATE OF WISCONSIN.

---

GEOLOGICAL AND NATURAL HISTORY SURVEY

---

BOARD OF COMMISSIONERS, 1902-1904.

ROBERT M. LaFOLLETTE,  
*Governor of the State.*

CHARLES P. CARY,  
*State Superintendent of Public Instruction.*

CHARLES R. VAN HISE, from July 1, 1903,  
*President of the University of Wisconsin.*

EDWIN E. BRYANT, died Aug. 10, 1903,  
*President of the Commissioners of Fisheries.*

CALVERT SPENSLEY, from Aug. 21, 1903,  
*President of the Commissioners of Fisheries.*

CHARLES S. SLICHTER,  
*President of the Wisconsin Academy of Sciences,  
Arts, and Letters, to Dec. 28, 1902.*

JOHN J. DAVIS,  
*President of the Wisconsin Academy of Sciences,  
Arts, and Letters, from Dec. 28, 1902.*

---

OFFICERS OF THE BOARD.

EDWIN E. BRYANT,  
*President until Aug. 10, 1903.*

CHARLES R. VAN HISE,  
*President, from Oct. 10, 1903.*

CHARLES P. CARY,  
*Vice-President.*

CHARLES S. SLICHTER,  
*Secretary, until Dec. 28, 1902.*

JOHN J. DAVIS,  
*Secretary, from Dec. 28, 1902.*

JOHN. J. KEMPF,  
*Ex-officio Treasurer.*

June 30, 1904.



## STAFF OF THE SURVEY.

---

EDWARD A. BIRGE, Ph. D., Sc. D., LL. D.,

*Director and Superintendent.*

CHARLES R. VAN HISE, Ph. D., LL. D.,

*Consulting Geologist until Oct. 10, 1903.*

THOMAS C. CHAMBERLIN, Ph. D., LL. D.,

*Consulting Geologist. Pleistocene Geology.*

SAMUEL WEIDMAN, Ph. D.,

*Geologist. Geology of Central Wisconsin and Baraboo District.*

LEONARD S. SMITH, C. E.,

*Assistant Professor of Topographic Engineering, University of Wisconsin. In charge of Hydrography.*

ULYSSES S. GRANT, Ph. D.,

*Geologist. Professor of Geology, Northwestern University. In charge of Survey of Southwestern Wisconsin.*

HEINRICH RIES, Ph. D.,

*Assistant Professor of Geology, Cornell University. In charge of Report on Clays.*

NEVIN M. FENNEMAN, Ph. D.,

*Professor of Geology, University of Wisconsin. Physical Geography of Lake District.*

WARREN D. SMITH, B. S.,

*Field Assistant, 1903. Geology of Baraboo District.*

E. T. HANCOCK, B. S.,

*Field Assistant, 1903. Southwestern Wisconsin.*

E. F. BURCHARD, B. S.,

*Field Assistant, 1903. Southwestern Wisconsin.*

M. J. PERDUE, B. S.,

*Field Assistant, 1904. Southwestern Wisconsin.*

FREDERICK L. GALLUP, B. A.,

*Field Assistant, 1904. Report on Clays.*

There were several other persons engaged in various capacities on the Survey, as stated on pages 11, 17, and 18.



## LETTER OF TRANSMITTAL.

---

COMMISSIONERS OF THE  
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY,  
MADISON.

*Office of the President.*

November 12, 1904.

Honorable ROBERT M. LA FOLLETTE,  
*Governor of the State.*

SIR:—I have the honor to transmit herewith the report of Dr. E. A. Birge, Director and Superintendent of the Geological and Natural History Survey, for the biennial period extending from July 1, 1902, to June 30, 1904.

At the beginning of this period the annual appropriation for the Survey was only \$5,000. At the session of 1903 the legislature increased the appropriation to \$10,000 per annum, the act taking effect May 6, 1903. As shown by the report of the Director and Superintendent, this increase in appropriation has made it possible for the Survey to push forward the economic work of importance to the state with a fair degree of speed. Perhaps the most important pieces of work which have been accomplished are: That by Dr. Samuel Weidman, upon the Baraboo Iron District, and that by Dr. U. S. Grant, upon the Lead and Zinc District of the southwestern part of the state. The report of Dr. Weidman is already published, and that by Dr. Grant is in preparation. It is certain that the results which these men have obtained will be of great assistance in the exploration and exploitation of these districts. Another important economic investigation is being carried on by Dr. Ries, upon the Clays of the State.

So far as consistent with the accomplishment of the neces-

sary economic work, scientific work is being carried on in Biology and Geology. It is hoped that in the future, the amount of such work may be increased.

Very respectfully yours,

CHARLES R. VAN HISE,  
*President of the Board of Commissioners.*

## REPORT OF THE DIRECTOR OF THE SURVEY.

---

### *To the Commissioners of the Geological and Natural History Survey:*

GENTLEMEN:—I submit herewith my report as Director of the Survey under your charge from July 1, 1902, to June 30, 1904. I include also a statement of the work of the Survey during the summer of 1904, thus giving an account of its operations up to the time when the report goes to press.

On August 10, 1903, Dean E. E. Bryant, President of the Commissioners of the Survey, died. Dean Bryant was a member of the Board of Commissioners from the organization of the Survey and for about two years, since the resignation of President Adams, was President of the Board. He was always deeply interested in the progress of the Survey. He gave his time freely to the work of the Survey and performed his duties as Commissioner with untiring zeal. His position as Commissioner of the Survey depended upon his place as President of the Commissioners of Fisheries, and he was succeeded in both positions by the Honorable Calvert Spensley of Mineral Point. Charles R. Van Hise, who has been Consulting Geologist of the Survey since its organization was elected President of the University in April, 1903. This appointment carries with it the position as Commissioner of the Survey. President Van Hise assumed his duties in the fall of 1903, when he resigned his position as Consulting Geologist and was elected President of the Commissioners of the Survey. The Survey is still able to avail itself of his counsel and assistance, which have been of so great value in the past.

At the date when this report opens, the income of the Survey was \$5,000 annually; this amount having been appropriated



by the legislature of 1901. The legislature of 1903 appropriated the additional sum of \$5,000 annually by an act which was approved May 6, 1903. Since that date, therefore, the income of the Survey has been \$10,000 annually, and its work has been correspondingly enlarged.

#### I. PERSONNEL OF THE SURVEY.

The following persons have been in the employ of the Survey during the past two years, with the compensation stated in each case. All persons who are paid by the year or month have been allowed their annual expenses while in the field, in addition to the compensation stated.

- E. A. BIRGE, Director and Superintendent of the Survey. The Director's salary was \$250 annually until May 1, 1903, and has been \$500 annually since that time.
- C. R. VAN HISE, Consulting Geologist until election as President, without compensation except repayment of field expenses.
- T. C. CHAMBERLIN, Consulting Geologist, without compensation, except repayment of field expenses.
- SAMUEL WEIDMAN, Geologist in charge of areal geology, \$1,400 per annum.
- U. S. GRANT, Geologist in charge of survey of lead and zinc region, \$125 per month during the summer of 1902, and \$150 per month during the summers of 1903 and 1904. Professor Grant has been engaged in the survey of the lead and zinc region for the three summers past. He prepared a preliminary report—Bulletin No. IX—from the field work done during the summer of 1902. In the two succeeding years he has been engaged in the field work necessary for a permanent report, set forth in detail in a later portion of this report.
- N. M. FENNEMAN, Geologist, physical geography of the lakes of Eastern Wisconsin, \$100 per month while employed. During the summer of 1902 Professor Fenneman completed the field work necessary for his report—Bulletin No. VIII, on The Lakes of Southeastern Wisconsin.
- W. D. SMITH, Field Assistant to Dr. Weidman during the summers of 1902 and 1903, \$40 per month during 1902 and \$60 per month in 1903.
- C. D. MARSH, Biologist, no compensation beyond expenses.
- L. S. SMITH, in charge of hydrography, \$5 per day while in the field. Employed for a few days only during the period covered by this report.

The following persons were employed as members of Professor Grant's field party in Southwestern Wisconsin during the summer of 1903:

E. S. Burchard .....	\$70 per month.
E. T. Hancock .....	70 per month.
M. J. Perdue .....	50 per month.
E. E. Ellis .....	50 per month.
R. I. Dugdale .....	30 per month.
B. Beninger .....	30 per month.
G. Fulcher .....	40 per month.
L. Smith .....	20 per month.

These persons were employed for various periods of three or four months, beginning in June, except Mr. Hancock, whose services extended until October 28.

Besides these persons named above, others have been employed for special services and for short periods: Prof. W. W. Daniells and Prof. Victor Lenher have made chemical analyses. W. H. Griffin of Washington, D. C., has prepared the maps for Professor Grant's final report, and other persons have been employed as draftsmen and in similar temporary capacities.

The names of all persons who have received money from the Survey, with the amount paid to each person, are given in the statement of expenses from the Secretary of State, which is appended to this report. In the case of those persons employed by the year or month, the sums indicated as paid to them include not only salaries but also all other payments to them, audited by the Secretary of State, including expenses while in the field and repayment of bills paid by them.

## II. FINANCIAL STATEMENT.

In the following table, I have summarized the expenditures of the Survey according to departments, thus indicating the main directions in which the money, appropriated by the state, has been expended. The result is as follows:

	1902-1903.	1903-1904.	Total.
Administration.....	\$463 52	\$1,558 27	\$2,021 79
Road Material and Clays .....	786 80	108 67	895 47
Areal Geology.....	2,979 29	3,036 38*	6,015 67
Lake Biology.....	758 97	362 06	1,121 03
Lake Survey.....	75 81	25 50	101 31
Southwestern Wisconsin....	1,193 54	3,683 83	4,887 37
Peat.....	229 06	.....	229 06
Forest Trees, etc.....	90 95	.....	90 95
Gauge Reading.....	.....	40 40	40 40
Total.....	\$6,677 94	\$8,815 11	\$15,493 05

\* Including Baraboo district.

The expenses for administration in 1903-4 are much larger than in any previous year. Included in this, however, are about two years' salary of the Director (August 1, 1902-June 30, 1904), amounting to \$812.50. There are, also, unusually large items for printing and postage, amounting to \$112. It was necessary, also, to remove the offices of the Survey from Science Hall to South Hall at the University, and to fit up the new rooms at an expense of about \$260. The expenses of removing the offices are included in this statement, as well as the ordinary current expenditures for the services of clerk, freight, express, expenses incidental to sending out bulletins, and all other matters which are not properly chargeable to the several departments.

The sums as given in my statement do not exactly agree with the totals derived from tables furnished by the Secretary of State. The figures which I give refer to claims audited at this office during the period covered by the report, and since several days can pass before claims sent to the office of the Secretary of State are there audited, it always happens that his report includes certain bills which are not included in mine, and excludes others which are included by me. The Secretary of



State also includes in his report items paid from the general fund for printing and engraving. Against the apparent balance of about \$1,185 on July 1, 1904, there were claims which had not yet come in, amounting to about \$500.

### III. WORK OF THE SURVEY.

During the summer of 1902 comparatively little work was started. The income of the Survey, then \$5,000 per annum, was so small that little could be done beyond continuing the investigations already under way. The most important new work undertaken during that season was the preliminary investigation of the lead and zinc region by Professor Grant. Dr. Weidman's work in Central Wisconsin was continued, and Professor Fenneman completed the field work for his report on the lakes. The addition of \$5,000 annually to the income of the Survey, by the legislature of 1903, made it possible to undertake new lines of investigation. As the first of these, the Survey carried on the investigation of the lead and zinc region, along the lines indicated in the last biennial report, and on this expended nearly \$3,700 during the year 1903-04. The Commissioners also attempted to begin work in the investigation of clays, but the Director was unable to find a person who was at once competent to carry on this investigation and whose services could be obtained for the sum at the disposition of the Survey. This work, therefore, was necessarily postponed until the season of 1904, when a portion of the work was placed in charge of Professor H. Ries of New York.

During the summer of 1903 Dr. Weidman, with the assistance of Mr. Smith, carried on the field work necessary to a report on the Baraboo iron-bearing district, in which active exploration was then going on. The preparation of this report necessarily delayed the completion of his work on the geology of Central Wisconsin, but the economic importance of the discovery of iron ore in this district seemed to warrant the diversion of his services to this field.

The Wisconsin State Board of Managers for the World's Fair at St. Louis requested this Survey to prepare an exhibit

of the minerals of the state for the World's Fair. This task occupied much of the time of Dr. Weidman and the Director during the winter of 1903-04. A more detailed account of the exhibit is given on following pages.

*A. Survey of the Baraboo District.* The discovery of large deposits of iron ore near North Freedom, in the vicinity of the Baraboo quartzite ranges, led the Survey to take up the investigation of this district. The object of the investigation was to ascertain the nature and occurrence of the ore and its relations to the rock formations of the vicinity, to prepare a geological map of the district and to furnish other information of value to those engaged in exploring and mining. In accordance with this plan, Dr. Weidman was instructed to discontinue his work in North Central Wisconsin for a time and prepare a report on the Baraboo district.

Work in the district was begun May 4th, 1903, by Dr. Weidman and his assistant, W. D. Smith, and about three months were occupied in mapping the various rock formations of the district. The preparation of maps and report was immediately begun, and the report was sent to the press in May, 1904, and was ready for distribution in the following August.

The report on the Baraboo district was issued as Bulletin XIII. It contains 200 pages and 23 illustrations, including a colored geological map of the district on the scale of 1 inch to the mile.

Iron ore in paying quantity was first discovered in the district three miles southwest of North Freedom by W. G. La Rue in April, 1900. Previous to this, however, 1887-9, explorations had been carried on by the Douglas Mining Company. This Company found only lean ore or paint rock and the Chicago & Northwestern Railway leased the property and mined the formation for mineral paint from 1889 to 1899.

The work of the successful exploratory company was carried on by churn and diamond drilling, the first ore located being the deposit of the present Illinois mine very near the former Douglas mine.

The Illinois mine is now shipping about 500 tons per day

to Chicago, and the shipment of the initial year, 1904, will probably be 75,000 to 100,000 tons.

The Sauk mine is located about one mile northeast of the Illinois mine. It is not yet shipping ore.

The rock formations in the Baraboo district, beginning with the youngest, are as follows:

- I. Glacial drift.
- Unconformity.
- II. Paleozoic Sedimentary Rocks. { Lower Magnesian Limestone.  
Potsdam Sandstone.
- III. Pre-Cambrian Sedimentary Rocks ..... { Freedom formation (dolomite and iron-bearing beds 1,000 feet thick).  
Seeley slate (gray clay slate, 600 feet thick).  
Baraboo quartzite (quartzite of Baraboo Bluffs, 3,000 to 5,000 feet thick).
- Unconformity.
- IV. Pre-Cambrian Igneous Rocks. { Rhyolite.  
Granite.  
Diorite.

The pre-Cambrian formations such as the iron-bearing formations, the slate and quartzite, stand on edge and dip in various directions, while the Paleozoic limestone and sandstone lie in horizontal position upon the upturned edges of the pre-Cambrian. The pre-Cambrian formations are folded in the shape of a trough, in such manner that the oldest igneous rocks are on the outer edge of the trough, outside the quartzite ranges, and the younger formations of slate and iron-bearing rock and ore are in the inside of the trough, which is the valley between the quartzite ranges.

The iron ore and associated rocks are of the same general age and character as those in the Lake Superior iron-bearing districts.

The iron ore occurs in irregular deposits in the iron-bearing formation. This formation, and also the associated slate and dolomite, appear nowhere at the surface, being covered over with from 200 to 500 feet of sandstone and surface material, and the explorations have to be carried on by churn and diamond drill through the overlying formations,



Considering the general result of exploration to date, and the extent of territory worthy of exploration, the district may be said to be one of considerable established value, and it may develop into as much importance as some of the Lake Superior districts.

The fact that the iron ore is overlaid with sandstone makes the explorations and sinking of shafts more difficult and expensive than in the Lake Superior districts, but the more favorable location of the Baraboo district with respect to the centres of the iron industry, and the manufacture of iron and machinery will more than offset this.

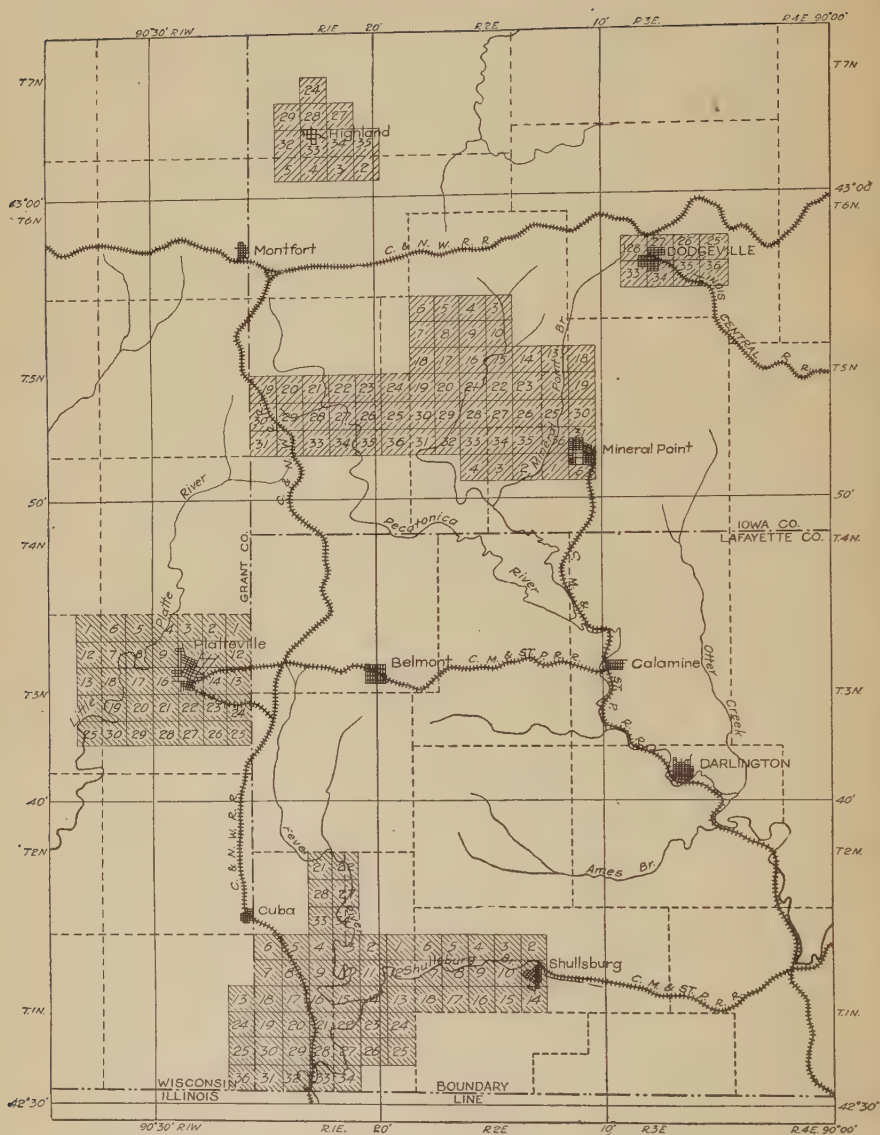
*B. Investigation of the Lead and Zinc District.* During the summer of 1902 Professor U. S. Grant made a preliminary investigation of this district and, as a result of this work, Bulletin No. IX was prepared and published. An account of this investigation is given in the last biennial report.

The work in this district during 1903 and 1904 consisted almost entirely of detailed mapping of the important ore-bearing areas. This mapping was done on the scale of 8 inches to the mile and it is expected that the maps will be published on the scale of four inches to the mile. In this work the geography, the topography and the geology were carried along hand in hand by the same individual. It is thought that in this manner it is possible to get the closest agreement between the three different features which must be represented on these maps.

It is hoped that these maps will be of considerable use to those interested in mining in this district, as they will be by far the most accurate maps yet published of this region, and as they will show, by ten foot contour lines, the details of topography, the location of the mines, and the old workings and the boundaries between the different geological formations. In addition to this, it is expected that contour lines will be drawn on the base of the Galena limestone, thus enabling any one to tell, within a very few feet, how far it is from the surface to the bottom of the chief ore bearing horizon.

The districts thus mapped in detail include 173 square





Map of areas surveyed in Southwestern Wisconsin. The Plattville and Shullsburg areas were surveyed in 1903; those at Mineral Point, Dodgeville and Highland in 1904.



miles. The maps are now being drawn and it is expected that they will be ready for publication this coming winter. The topographic control for these maps was obtained by lines of leveling carried along most of the roads of the district, these levels being tied to accurate bench marks established by the U. S. Geological Survey.

The areas mapped in 1903 are as follows:

<i>Platteville area</i> , sections 1 to 25 inclusive of T. 3 N., R. 1 W., and sections 1, 12, 13, 24 and 25 of T. 3 N., R. 2 W. ....	35 sq. mi.
<i>Hazel Green-Benton area</i> , sections 1 to 34 inclusive of T. 1 N., R. 1 E., and 13, 24, 25 and 33 of T. 1 N., R. 1 W. ....	38 sq. mi.
<i>Meeker's Grove area</i> , sections 21, 22, 27, 28, 33 and 34 of T. 2 N., R. 1 E. ....	6 sq. mi.
<i>Shullsburg area</i> , sections 2 to 11 inclusive, and 14 to 18 in- clusive of T. 1 N., R. 2 E. ....	15 sq. mi.

The areas mapped in 1904 are as follows:

<i>Mineral Point-Linden area</i> , sections 3 to 10 inclusive, and 13 to 36 inclusive of T. 5 N., R. 2 E., sections 18, 19, 30 and 31 of T. 5 N., R. 3 E., sections 1, 2, 3 and 4 of T. 4 N., R. 2 E., and 6 of T. 4 N., R. 3 E. ....	41 sq. mi.
<i>Mifflin area</i> , sections 19 to 36 inclusive of T. 5 N., R. 1 E. ....	18 sq. mi.
<i>Highland area</i> , sections 24, 27, 28, 29, 32, 33, 34 and 35 of T. 7 N., R. 1 E., and sections 2, 3, 4 and 5 of T. 6 N., R. 1 E. ....	12 sq. mi.
<i>Dodgeville area</i> , sections 25, 26, 27, 28, 33, 34, 35 and 36 of T. 6 N., R. 3 E. ....	8 sq. mi.

The party engaged in this work for 1903 was as follows:

E. F. Burchard, topography and geology (in charge of the party during the absence of Prof. Grant).  
E. T. Hancock, topography and geology.  
E. E. Ellis, topography and geology.  
M. J. Perdue, topography and geology.  
A. F. Crider, topography and geology (for part of the season).  
Richard Dugdale, levelman (for part of the season).  
Gordan Fulcher, levelman (for part of the season).  
Louie Smith, rodman (for part of the season).  
J. J. Hareleroad, rodman (for part of the season).  
Bert Beninger, cook.

The party for 1904 consisted of the following:

- M. J. Perdue, topography and geology (in charge of the party during the absence of Prof. Grant).  
E. E. Ellis, topography and geology (for part of the season).  
G. H. Cox, topography and geology.  
Gordan Fulcher, topography and geology.  
J. R. Banister, topography and geology.  
G. H. Cady, rodman (for part of the season, later, topography and geology).  
B. J. Spence, levelman.  
C. S. Blair, levelman.  
W. J. Reed, rodman.  
J. L. Moss, rodman (for part of the season).  
George Stoker, cook.

During the season of 1904 the work was carried on under informal co-operation with the United States Geological Survey. In this way the work was divided somewhat as follows:

1. The Wisconsin Geological and Natural History Survey undertook the detailed mapping of certain of the important areas, as described above.
2. The United States Geological Survey undertook the preparation of a map and description of the Mineral Point quadrangle. This work was done by Prof. U. S. Grant assisted by A. F. Crider.
3. The United States Geological Survey undertook the preparation of a monographic account of the Upper Mississippi Valley lead and zinc district, including especially that part of this district in Wisconsin. This work was done by Dr. H. Foster Bain, assisted by E. E. Ellis.

With the completion of this season's work and the preparation of the reports above outlined there will be accomplished the following objects:

1. The detailed mapping of the chief ore-bearing districts. This will be accompanied by a general description of the maps and by maps of the mines. To be published as a bulletin of the Wisconsin Geological and Natural History Survey.

2. A description of the general geology and mineral resources of a considerable part of the lead and zinc region. To be published as a geologic folio of the United States Geological Survey. If it is desired it is probable that arrangements can be made for the republication of this folio as a bulletin of the Wisconsin Geological and Natural History Survey.
3. A careful scientific presentation of the facts and theories concerning the ore deposits of the whole Upper Mississippi Valley district, which can be treated adequately only by including all of the district, and not by dealing merely with one part of it. To be published, probably as a professional paper, by the United States Geological Survey.

*C. Investigation of the Clays.* Professor Heinrich Ries of Cornell University was engaged to take up the investigation of the clays during the summer of 1904. His work began in June of that year. An account of it is given here, although most of it was done at a date subsequent to the close of the fiscal year 1903-04. Professor Ries has reported on the clays of several of the states of the Union and is, therefore, one of the most skillful investigators of the problems offered by the clay industry. His work during the season is summarized as follows:

During the summer of 1904 Professor Ries spent about two and a half months in the field in Wisconsin and his assistant, Mr. Gallup, spent three months. In the course of this work all of the important clay working plants in the state were visited as well as many of the smaller ones, only those being omitted which were a considerable distance from the railroad. At each of the works a careful inspection was made of the method of work, of the clay and the results obtained and where it was evident that improvements could be made the fact was noted. Large samples of clay were taken from nearly all of the deposits for the purpose of being tested in the laboratory in order to determine from their physical qualities whether it was likely that these materials could be used for making the

better class of clay product than is now being made from them. Where it seemed practicable to work the different beds in the bank separately a separate sample of each was taken, otherwise it was the run of the bank that was usually selected for testing.

A second line of work undertaken was the distribution among the brick workers of Seger cones for the purpose of testing the amount of heat contained in their kilns. One of the objects of determining the amount of heat obtained was to see whether the brick were burned at a temperature too low to obtain the best results. Another object was to find out whether it required more heat to burn the Wisconsin clays than others with which they came into competition and which were said to burn at a lower temperature. The majority of the brick manufacturers to whom these cones were given took a lively interest in the matter and with few exceptions carefully followed the instructions regarding their use. Most of the samples distributed have already been returned and they show quite a wide variation in the amount of heat employed in different parts of the state for burning brick. It can be said as a general rule that the cream burning estuarine and lake clays worked in the eastern part of the state are burned at a higher heat than the low burning clays found in other parts of the state.

The third line of work was the careful selection of a set of normal burned bricks from almost every yard visited. These were shipped to Madison where they will be put through crushing, cross breaking, and absorption tests. From these tests, which will probably be the most extensive series of the kind ever taken in this country, many instructive data will be obtained.

The large samples of clay which were collected in the field have been shipped to the laboratory for a series of physical tests. These physical tests will include the determination of the color, shrinkage, hardness, and density to which the clay burns at different temperatures, as well as a determination of its fusing point, tensile strength, plasticity, percentage of water required to mix with it, and soluble salts. The



results of these tests will give many valuable clues regarding the possible uses of the clay. Where it seems desirable mixtures of the clays will be tested in order to bring out all their qualities.

Since the preliminary work done on the clays by Dr. Buckley the industry has undergone some important changes. Some yards have improved their equipments, other yards have ceased operation, while in some localities new yards have been started.

An interesting fact is the establishment of the manufacture of sand-lime brick in Wisconsin, for the manufacture of brick from sand. This is a new and growing industry in the United States and Wisconsin contains deposits of sand which in many cases are excellently adapted for the manufacture of this kind of brick.

In addition to the clay investigation, a study of the molding sands was also taken up. Wisconsin contains over 150 foundries all of which are using one or more grades of molding sand, while in many cases the raw material is obtained from within the state, while in others the finer sand is obtained from neighboring states, and the question therefore arises whether it is not possible to find these finer grades in Wisconsin.

Comparatively little has been done towards investigating the physical and chemical qualities of molding sand in the laboratory and it seems that there is an important field here for this line of work. Up to the present time most foundry men judge a molding sand by giving it a practical test in the foundry, but this sometimes involves considerable expense and time and the fact that certain large and enterprising foundry firms have drawn up specifications covering the physical and chemical qualities of molding sands shows that it is undoubtedly possible to obtain some valuable information from the study of these materials of this matter, and in the Wisconsin work a number of foundries were visited and as many data as possible obtained regarding the use of molding sands in different kinds of work. The molding sand pits in Wisconsin were visited and samples obtained from them. Samples were also collected of the sands which are imported into the state

and it is proposed to make a careful chemical and physical study of these sands in the laboratory.

*D. Areal Geology.* The latter portion of the year 1902, subsequent to July 1st, was occupied in completing the field work in the area of North Central Wisconsin. In this work Dr. Weidman was assisted by Mr. W. D. Smith, and during this period portions of the area included in Taylor, Price and Portage Counties were surveyed.



Map showing location of North Central Wisconsin district.

The survey of the area designated as North Central Wisconsin was therefore completed in the field season of 1902. This area, represented by the shaded portion of the accompanying map of the state, includes Portage, Wood, Clark, Marathon,

Lincoln and Taylor counties, with adjoining portions of Langlade, Price and Gates counties. The area comprises 201 townships with an approximate extent of 7,200 square miles, about one-eighth of the state. The area is considerably larger than that of Connecticut and a little less than that of New Jersey.

It was originally planned to survey and report upon a much smaller area than this is, about 3,000 square miles in the vicinity of Wausau, but on account of the complex character of the crystalline geology it was necessary to cover a larger area and examine a larger number of rock exposures in order to work out the true relations of the various formations. It was originally planned also to report only upon the crystalline rocks of the area, but this plan has been enlarged and made to include a report of all the geological formations of the area, which are, besides the crystalline rocks, the formation of Potsdam sandstone and the various glacial drifts. The soil map and soil report, which it is believed will be of great practical value to those interested in the agriculture of this part of the state, is also a direct outcome of the enlarged plan and is based upon information collected in connection with the survey of the glacial drifts and other surface formations of the area.

The report on the geology of the area (delayed to prepare the report on the Baraboo iron district) will contain a description of the general geology, mineral resources, physical geography and soils.

The description of the geology is necessarily written from the scientific standpoint. The geological formations of the area range from the most ancient crystalline formations, known in geology, to the newest glacial deposits. The crystalline formations include all the groups of igneous and also such metamorphic sedimentary rocks, as quartzite, slate, and conglomerate. In carrying on the work of the survey every ledge of rock was examined, located on the section map, and specimens collected for study under the microscope or by chemical analysis. It is among the metamorphic sedimentary rocks that iron ores are likely to occur. In mapping the geological formations a number of occurrences of banded slate, the formation closely associated with the iron ores of the Lake Superior

region, were found; while these occurrences of banded slate led to no discovery of iron ore in this area, their presence here is at least encouraging and seems to indicate the probability of other areas of slate and possibly of some iron ore in the unmapped portion of the State farther north.

The glacial drift of the area includes the deposits of drift of several distinct and widely separated glacial periods. In all, four drift formations, and possibly five, have been distinguished and mapped. While the mapping of the various drifts may at first sight appear to be of scientific interest only, it really has a great practical value, for the age and character of the drift directly controls the soil and agricultural conditions of the area.

The mineral resources include the various rock products of the area which have, or may have, an economic value. These include granite used for cemetery and building purposes, the sandstones used for building purposes, the deposits of quartz rock used as an abrasive and for other purposes, the various crystalline rocks suited for road material, the brick clays, the marl and peat deposits, and the water supply.

The physical geography of the area includes the description of the various land forms of the area and the history of their development.

The general report and map of the soils of North Central Wisconsin was issued in 1903 as Bulletin XI. It describes the various soils of the area, and the area occupied by each is shown on a colored map. The soils of the area are described with respect to their area, surface features, character and origin, ground water, forest growth, and crops. An account of the climate and rainfall, and conditions of agriculture in the area is also presented.

After the field work in the Baraboo district was completed in 1903, field work in Northern Wisconsin was resumed in Chippewa and Eau Claire Counties.

*E. Aid to Forestry Commission.* The Wisconsin Forestry Commission requested the Survey to aid them during the summer of 1904 in the examination of the general topography



and the surface geology in the districts investigated by them. Mr. E. T. Hancock was assigned to this duty and spent about three months in the northern part of the state, working under the direction of Mr. E. M. Griffith. In connection with the work done for the Forestry Commission, Mr. Hancock examined the surface geology, especially with reference to the glacial geology.

*F. Peat.* During the year 1903 Professor A. W. Richter carried on a preliminary investigation of the peat marshes of the state, to which attention had been directed by the high price of coal. Some \$230 were used in this investigation; all of it devoted to paying the necessary expenses. The investigation showed, as would be expected, that there is in the state an abundance of peat of good quality, which would make good fuel if properly dried and compressed. It appears also that many peat beds contain so large an amount of sand and similar material that the percentage of ash would be quite too high for fuel. It also was evident that the great amount of water to be evaporated from the peat makes the preparation of fuel from this source so expensive that very careful business management is necessary if it is to be put on the market at a price at which it will compete with coal and yet be sold at a profit. It seems hardly probable that peat can be made to compete with coal on a large scale when the price of the latter is at its normal level.

*G. Lake Biology.* Very little field work was done during the biennial period on the biology of the lakes. Bulletin No. XIII was published, as is stated under the heading Publications. Mr. Juday, who was biological assistant during the year 1900-01, published in the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters a paper on the Diurnal Movement of the Crustacea of the Wisconsin Lakes, based on observations made while assistant on the Survey. During the summer of 1904 I devoted most of my time to working over the material for my report on the temperatures of the lakes of Southern and Eastern Wisconsin. Occasionally observa-

tions on temperature have been made on various lakes in each of the seasons covered by this report but no regular field work has been done.

During the current year the Survey is attempting one comparatively small piece of investigation on the lakes. Dr. Victor Lenher, of the University of Wisconsin, has begun the study of the chemical relations of the lakes and hopes during the year to complete an examination of the chemistry of the waters of the more important lakes, and also of the gases dissolved in the water. One of the most puzzling problems of lake biology lies in the great difference in the abundance of life in lakes which are near each other and which appear to be, in general, similar. It is hoped that this investigation may throw some light upon this problem, which is a fundamental one for the economic utilization of these waters.

*II. State Mineral Exhibit at the Louisiana Purchase Exposition.* The Wisconsin Board of Commissioners requested the Survey to make a suitable exhibit of the mineral resources of the state for the Louisiana Purchase Exposition at St. Louis. The preparation of such an exhibit should naturally and properly be the duty of the Survey and to this duty much of the time of the Director and Dr. Weidman was given during the winter and spring of 1904. The Survey had in its possession the nucleus of an exhibit, such as representative samples of many of our building stones, brick, tile and clay, but in order to make a satisfactory exhibit, much additional material had to be collected, and special charts, models, and maps had to be made. Important aid in planning and constructing the special models was given by Professor C. K. Leith.

For the preparation, installation, and maintenance of the mineral exhibit a sum not to exceed \$5,000.00 was allotted by the Board of Wisconsin World's Fair Commissioners. Dr. Weidman was placed in general charge of the exhibit, and an assistant, Mr. E. T. Hancock, was appointed, whose salary was paid out of the funds allotted for the exhibit. It may be stated, in passing, that the Survey contributed the services of Dr. Weidman, no extra salary from state funds being paid

to him, or to others regularly connected with the staff of the Survey, for services rendered to the World's Fair Commission. Expenses only were charged to the World's Fair funds.

*Plan of the Exhibit.* In preparing the exhibit, it was planned to make a representative display of all the natural resources of the state, but to place special emphasis on the building stone industry and the lead and zinc mining industry. The high cost of installing an exhibit and its general maintenance, coupled with the small fund available for the mineral exhibit, would not permit an elaborate display of all our natural resources. The space allotted to the exhibit was 40 x 40 feet in the Palace of Mines and Metallurgy.

*Lead and Zinc Mining.* The exhibit of the lead and zinc mining industry consisted of a display of large samples of the lead and zinc ore from various mines, a large model of a lead and zinc deposit made out of the natural ore and associated rock, a glass model of one of the large mines, and samples of lead and zinc concentrates and zinc spelter.

*Building Stone and Quarrying Industry.* In value of various kinds of stone produced in 1903, Wisconsin ranked 11th among the states of the union, our total value being \$1,972,497.00. In the Mississippi Valley Wisconsin is the leading state in annual production of granite products.

The exhibit consisted of dressed 8-inch cubes of the various kinds of granite, sandstone and limestone, used for building and monumental purposes, polished columns and slabs of granites used for monuments, granite paving blocks, granite macadam, crushed quartz, and hydraulic cement stone.

*Iron Ores.* The most important mineral resource of Wisconsin is iron ore, in which in 1903 she ranked 6th in amount of ore produced, and 4th in value of the ore, among the states of the Union. The exhibit of iron ore consisted of a display of samples of the iron ores from the mines on the Wisconsin end of the Gogebic and the Menomonic iron ranges, from the Baraboo range and from the Iron Ridge and Spring Valley mines.

*Clay Products.* Representative samples of the brick, tile,

and clays of our state were presented, and a display of the Norse Pottery Company's pottery of Edgerton was made.

*Maps, Charts, and Views.* Large maps of the state were specially drawn to show the location of the various mineral resources of the state and to show the location of the developed and undeveloped water powers of the state. A cross section of the Baraboo iron bearing district was shown, and various maps of the geology, soils, and lakes, etc., were exhibited, and numerous photographic views of Wisconsin scenery were displayed.

*Awards.* The State, through the work of the Survey, received high awards for its principal mineral exhibits. A gold medal was awarded for the model representing the deposits of lead and zinc ores; a silver medal for the exhibit of building and monumental stone; and a silver medal for the general plan and material of the state exhibit as a whole.

#### IV. PUBLICATIONS.

During the period covered by this report five bulletins were issued and a sixth was published after July 1, 1904, but before the date of going to press. The titles of these bulletins are as follows:

- Bulletin No. VIII. Educational Series No. 2. The Lakes of Southeastern Wisconsin. N. M. Fenneman, Ph. D., Professor of General and Geographic Geology, University of Wisconsin. 1902. Pp. XV, 178; 36 plates; 38 figures in the text.
- Bulletin No. IX. Economic Series No. 5. Preliminary Report on the Lead and Zinc Deposits of Southwestern Wisconsin. Ulysses Sherman Grant, Ph. D., Professor of Geology, Northwestern University. 1903. Pp. VIII, 103; 2 maps; 2 plates; 8 figures in the text.
- Bulletin No. X. Economic Series No. 6. Highway Construction in Wisconsin. Ernest Robertson Buckley, Ph. D., State Geologist of Missouri, formerly Geologist, Wisconsin Geological and Natural History Survey. 1903. Pp. XVI, 339; 103 plates; including 26 maps of cities.
- Bulletin No. XI. Economic Series No. 7. Preliminary Report on the Soils and Agricultural Conditions of North Central Wisconsin. Samuel Weidman, Ph. D., Geologist, Wisconsin Geological and Natural History Survey. 1903. Pp. VIII, 67; 10 plates, including soil map.
- Bulletin No. XII. Scientific Series No. 3. The Plankton of Lake Winnebago and Green Lake. C. Dwight Marsh, Ph. D., Professor of Biology, Ripon College. 1903. Pp. VI, 94; 22 plates.



The following bulletin was published in August, 1904:

Bulletin No. XIII. Economic Series No. 8. The Baraboo Iron-Bearing District of Wisconsin. Samuel Weidman, Ph. D., Geologist, Wisconsin Geological and Natural History Survey. 1904. Pp. X, 190; 23 plates, including map of district; 3 figures in the text.

Bulletin No. VIII was issued early in the year 1903 and was described in the last biennial report, page 19. The same may be said of Bulletins Nos. IX and X, both of which were issued in 1903 and of which the synopsis was given in the same report. Bulletin No. XI was printed in 1903 but was not distributed until the early part of 1904. This bulletin, which describes the soil conditions in Central Wisconsin, is really a portion of a general report on the geology of that region which Dr. Weidman is preparing and was issued in advance of the publication of the full report. A large edition of this bulletin was printed. It has been in great demand and the edition will soon be exhausted. Bulletin No. XII belongs to the scientific series of publications and contains the results of studies made on the plants and animals of the open water of Lake Winnebago and Green Lake by Professor Marsh. It is one of the most important contributions to this line of study which has been made in this country.

#### PLANS FOR FUTURE WORK.

The increase of the permanent income of the Survey to \$10,000 annually in 1903 made it possible for the commissioners to undertake several new investigations. The work for the immediate future was, however, determined by plans which had already been formed. The bill which increased the income of the Survey contained directions to the commissioners to investigate especially the lead and zinc region of Southwestern Wisconsin, and to continue the investigation of the clays of the state. The first of these investigations had been commenced in 1902. It has been continued vigorously during both of the following seasons and the field work for a final report is now complete. More than half of the addition to the income of the Survey has been spent in this direction but there will not be the

necessity for equally large expenditures in future years unless the mineral bearing districts should be considerably enlarged.

It was impossible to begin work on the clays in 1903, partly because, under a ruling of the Secretary of State, the income of the Survey for 1903 was less than had been anticipated, and also because no one could be found who was competent to conduct the investigation and whose services could be secured for a salary which the Survey could afford. In 1904, however, the services of Professor Ries were secured—one of the first experts on this subject in the country—with the view of completing as promptly as possible the work begun by Dr. Buckley, and partly published in Bulletin No. VII of this Survey. In that bulletin Dr. Buckley discussed the general conditions of the clay industry and gave the results of microscopical and chemical studies on the clays. The physical tests, such as the effect of burning, etc., were left for a future report. It is expected that this portion of the work will be finished as rapidly as possible by Professor Ries; thus completing a report on the clay industries of the state. This work should be finished during the current year.

A third large undertaking of the Survey is also drawing to its completion, namely: the geology of the district which we have called North Central Wisconsin, whose geology has been studied by Dr. Weidman since the founding of the Survey. Dr. Weidman is now engaged in preparing his final report on this district. A portion of his report has already been issued as Bulletin No. XIII, dealing with the soils of the region in question. The preparation of the geological report ought not to consume a longer time than the current year.

The completion of these investigations, however, will consume almost the entire income of the Survey for the year 1904-05, and it will not be possible to enter on new investigations of great importance during the current year. Under these circumstances, it is probably inadvisable to make definite plans for future work at this time, but some of the plans may be sketched which the Commissioners should consider during the year.

A large amount of work will remain to be done on the clays

of the state after the completion of Professor Ries' report. This report, with that of Dr. Buckley, furnishes the basis for further work rather than the completion of the service which the Survey can render to the clay industry. If this industry is to advance in the state, it will be necessary to provide some means by which the clays of the state can be studied systematically and tested with reference to their availability for various products, especially of the higher class. This cannot be done by a single investigation in the course of a single year but provision should be made by which the studies on this subject can be carried on regularly through an indefinite period. It may be advisable to combine with this work the subject of the economic geology of the state in general, so as to test road material, building stone, and other mineral products in the same laboratory, and to provide for the collection of mining statistics and other information of a similar type. It appears to me that a considerable portion of the future income of the Survey must be spent in these general directions.

Plans must also be made for a continuation and extension of the study of the areal geology of the state after the completion of the report on North Central Wisconsin. It will probably be found advisable to begin the careful study of the quartzite areas in Barron and Chippewa Counties and the adjacent formations. This region is so similar to the Baraboo district that there is at least a possibility of iron ore being found there. Preliminary explorations have already begun in this district and the Survey should lend such aid to exploration as can be given by a geological survey.

In future years the Survey should expect to spend a larger amount of money than in the past in studying of the natural history of the state. The necessity for pressing the completion of important pieces of economic geological research has hitherto made it impossible to devote much money to this branch of the Survey. The biological investigation of the lakes should be resumed and carried forward. If possible, it would seem to me advisable also to prepare a report on the fishes of the state, treating the subject both from the scientific and the economic points of view. The hydrographic survey should be extended

to those few important lakes in the southern and eastern portion of the state which have not yet been sounded. It does not seem to me advisable to attempt the extension of this portion of our work to the numerous lakes in the northern part of the state, where the maps of the country are grossly imperfect and where, therefore, a very large amount of ordinary mapping must be done before the hydrography would be of service.

It is obvious that the energies of the Survey must move in these general directions and it will be necessary for the commissioners to formulate plans during the present year on which the Survey may work during the years immediately following.

Respectfully submitted,

E. A. BIRGE,

*Superintendent and Director.*



## APPENDIX.

### FINANCIAL REPORT—FROM SECRETARY OF STATE—GEOLOGICAL SURVEY.

July 1, 1902—June 30, 1903.

American Express Co. ....	\$92 95	.....
Birge, E. A.* .....	535 40	.....
Buckley, E. R. ....	646 60	.....
Craig, T. J. ....	45 00	.....
Chamberlain, T. C. ....	22 94	.....
Clark Engraving Co. ....	290 20	.....
Crawford, D. A. ....	101 10	.....
Cheney, L. S. ....	54 00	.....
Denniston, F. R. ....	93 00	.....
Democrat Printing Co. ....	3,892 37	.....
Davis, Robt. M. ....	12 60	.....
Daniels, W. W. ....	102 00	.....
Davis, J. J. ....	18 76	.....
Elsom, J. C. ....	40 66	.....
Fenneman, N. M. ....	25 00	.....
Fuller, Roy E. ....	9 30	.....
Fleith, H. G. ....	12 50	.....
Friendberg, A. F. ....	28 00	.....
Findorff, J. H. ....	50 00	.....
Grimm, G. & Son ....	6 30	.....
Grant, U. S.†.....	1,001 14	.....
Gurley, W. & L. E. ....	90 00	.....
Hadfield, R. H. ....	102 51	.....
Johnson, Arthur L. ....	47 83	.....
Kable, J. F. ....	52 50	.....
Kahn, Gustav E. ....	72 00	.....
Knox, Arthur ....	24 70	.....
Kinnie, W. S. ....	26 40	.....
Keachie, Geo. R. ....	52 27	.....
Kemmerer, Geo. ....	25 95	.....
Lenher, Victor ....	129 86	.....
Lottes, W. G. ....	7 00	.....
Marshall Field & Co. ....	25 20	.....
Marsh C. Dwight ....	29 85	.....

\* Salary, expenses, and bills paid.

† Salary and expenses.

North Western Lithograph Co. ....	2,142 16	.....
Naramore, F. A. ....	27 00	.....
Ohms, Fred C. Son ....	20 90	.....
Phillips, J. D. ....	6 00	.....
Rechter, A. W. ....	4 20	.....
Smith, Lona H. ....	15 50	.....
Smith, Warren D.* ....	406 67	.....
Sanford, F. G. ....	130 00	.....
Strobach, Lena ....	40 00	.....
Sumner, E. & Son ....	5 00	.....
Tabor Pump Co. ....	42 50	.....
The Kny Scheerer Co. ....	24 00	.....
United States Express Co. ....	93 32	.....
University Co-operative Co. ....	18 70	.....
Van Hise, C. R. ....	5 90	.....
Weidman, Samuel* ....	1,991 82	.....
Wilson, John ....	10 40	.....
Wright, R. L. ....	21 35	.....
		\$12,771 31

\* Salary and expenses.

## FINANCIAL REPORT—FROM SECRETARY OF STATE—GEOLOGICAL SURVEY.

July, 1903—June 30, 1904.

Chase, H. G. ....	\$34 10	.....
Abercrombie & Fitch .....	48 30	.....
Burchard, E. F. ....	168 64	.....
Dugdale, Richard .....	61 15	.....
Grant, U. S.* .....	1,556 51	.....
Hancock, E. T.* .....	392 65	.....
Crawford, C. A. ....	14 25	.....
Ellis, E. E. ....	199 62	.....
Perdue, M. J. ....	184 17	.....
Marshall, Field & Co. ....	11 50	.....
Smith, Louis .....	40 25	.....
Steinhoff & Stevens .....	26 55	.....
American Express Co. ....	225 46	.....
Weidman, Samuel* .....	1,936 34	.....
Jennings & Nehis .....	16 50	.....
Smith, W. D.* .....	267 99	.....
Smithsonian Institution .....	62 35	.....
Beringer, Peter .....	60 00	.....
Lenher, Victor .....	291 00	.....
Chase, H. G. ....	19 34	.....
Harderood, J. M. ....	28 25	.....
Stadel, Ernest .....	45 46	.....
Callaghan Co. ....	32 20	.....
Ohms, T. C., & Sons .....	56 50	.....
Wright, Robert L. ....	37 80	.....
Birge, E. A.† .....	1,038 66	.....
Democrat Ptg. Co. ....	1,004 77	.....
Westenhaver, Lulu M. ....	42 18	.....
Fulcher, G. S. ....	56 34	.....
U. S. Express Co. ....	139 37	.....
Sanford, Fannie G. ....	140 50	.....
Buchan & Allen .....	78 05	.....
Respin, Frank .....	27 50	.....
Gurley, W. & L. E. ....	78 82	.....
Burroughs, C. A. ....	10 50	.....
Graff, C. F. ....	49 70	.....
Cantwell, F. W. ....	78 25	.....
Hebenstreit, John .....	80 16	.....
Schmohl, J. G. ....	36 00	.....
Harper, B. ....	26 29	.....
Remington Typewriter Co. ....	15 50	.....
Crider, A. F. ....	26 00	.....
Whitall Tatum Co. ....	8 75	.....
Marsh, C. Dwight .....	17 99	.....
King, Max W. ....	24 50	.....
Clark Eng. Co. ....	2 21	.....

\*Salary and expenses.

†Salary, expenses and bills paid.

Northwestern Lith'g Co. ....	1,257 96	.....
Drury, A. L. ....	59 40	.....
Grimm's Book Bindery ....	3 65	.....
Daniels, W. W. ....	128 00	.....
Griffin, W. H. ....	438 14	.....
Moseley, Jas. E. ....	39 50	.....
Mackin, Jas. ....	40 40	.....
University Co-op. Co. ....	9 77	.....
Park, W. J., Co. ....	10 80	.....
Ridgeway, J. L. ....	45 50	.....
Upfield, Jessie ....	98 60	.....
Montz, E. A. ....	25 00	.....
Hoen, A., & Co. ....	340 00	.....
Kemmerer, Geo. ....	8 00	.....
Ries, Henrich ....	82 19	.....
Kinne, W. S. ....	5 25	.....
Fries, Scott W. ....	12 00	.....
Kny-Scheerer Co. ....	225 05	.....
Riley, E. F. ....	223 20	.....
Tyrrell, Jos. ....	35 50	.....
		\$11,836 83



## STATUTES OF WISCONSIN RELATING TO THE GEOLOGICAL AND NATURAL HISTORY SURVEY.

## CHAPTER 297, LAWS OF 1897.

An Act to provide for the investigation of the natural resources of the state of Wisconsin, and providing an appropriation therefor.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. There is hereby constituted a geological and natural history survey of the state of Wisconsin.

SECTION 2. This survey shall have for its object:

(1) The completion of the geological survey of the state, and especially the examination of the rocks, with reference to the occurrence of iron ores, building stones, and other valuable mineral products, and in reference to their value as material for road construction.

(2) A study of the soils of the state.

(3) A study of the plants of the state, and especially of the forests, with reference to their cultivation and preservation.

(4) A study of the animal life of the state, and especially the occurrence, distribution and production of fish in the lakes and streams of the state, and a study of foods and enemies of fish.

(5) The preparation of an account of the physical geography and natural history of the state, in such form as to serve as manuals for the public schools, and of special reports on subjects of economic importance, in such form as to be of direct service to the people.

(6) The completion of the topographic map of the state begun by the United States Geological Survey; but no money shall be expended for topography unless an equivalent amount be expended for this purpose in the state by the United States government.

SECTION 3. This survey shall be governed by a board of commissioners, consisting of the governor of the state, the state superintendent of public instruction, the president of the state university, the president of the commissioners of fisheries, and the president of the Wisconsin Academy of Sciences, Arts, and Letters. The commissioners shall meet within thirty days after the passage of this act, and organize as a commission and adopt by-laws for their government, not inconsistent with law, and shall meet at such time and places as they may prescribe. A majority shall be a quorum. They shall receive no compensation, but each shall be reimbursed his expenses actually and necessarily incurred in the performance of his official duties, out of such appropriation as may be made by the legislature. They shall choose from their number a president, secretary, and such other officers as their by-laws may prescribe; but no officer shall receive any compensation, except such as is herein provided for. The commissioners shall have general charge of the survey, and shall appoint a superintendent of the survey, and, on his nomination, such assistants and employes as they may deem necessary. They shall fix the compensation of all persons employed in the survey, and may remove them at pleasure.

SECTION 4. It shall be the duty of the commissioners to prepare a report before the meeting of each legislature, showing the progress and condition of the survey, giving an account of money spent together with such other information as may be deemed necessary and useful. The superintendent shall transmit to the commissioners, from time to time, special reports, with necessary illustrations and maps, as these are com-

pleted. If approved by the commissioners, they shall be transmitted to the commissioners of public printing, who are authorized to have the reports published in a suitable manner, as independent reports, as bulletins of the state university, or in the transactions of the Wisconsin academy of sciences, arts, and letters, as the commissioners of the survey deem best. If published as independent reports, it shall be the duty of the commissioners of public printing to decide as to the number of copies in the edition of each particular report. Five copies of each report shall be delivered to each of the state officers, and to each member of the legislature. The number of copies provided by law for other public documents shall be furnished to the state historical society, the library of the state university, and other state institutions. The remainder of the independent reports shall be distributed, used in exchange, or sold by the commissioners of the survey, as the interest of the state and of science demands. All moneys obtained by the sale of the report shall revert to the state treasury, as a part of the general fund. Volumes obtained in exchange for the reports shall be added to the library of the Wisconsin academy of sciences, arts, and letters. The superintendent of public property shall furnish, upon the requisition of the president of the commissioners of the survey, such stationery and postage stamps as may be necessary for the use of the commissioners and the superintendent of the survey in official business.

SECTION 5. After material collected shall have served for the purposes of the survey, it shall be distributed to the state university, the colleges of state, the state normal schools, and the free high schools of the state, under the approval of the commissioners of the survey, in such a manner as to be of the greatest advantage to education in the state.

SECTION 6. There is hereby annually appropriated for two years to the commissioners of the geological and natural history survey, out of any money in the treasury not otherwise appropriated, the sum of \$5,000, the first appropriation to be paid in the current fiscal year.

SECTION 7. This act shall take effect and be in force from and after its passage and publication.

Approved April 22, 1897.

## CHAPTER 163, LAWS OF 1899.

An Act to appropriate a sum of money for the further prosecution of the geological and natural history survey of the state.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. There is hereby appropriated for the further prosecution of the geological and natural history survey, out of any money in the treasury not otherwise appropriated, the sum of ten thousand dollars annually for the term of two years. This money shall be expended by the commissioners of said survey for the purpose of executing the duties assigned to them by chapter 297 of the laws of 1897.

SECTION 2. This act shall take effect and be in force from and after its passage and publication.

Approved April 12, 1899.

## CHAPTER 375, LAWS OF 1901.

An Act to appropriate a sum of money for the further prosecution of the geological and natural history survey of the state.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. There is hereby appropriated for the further prosecution of the geological and natural history survey, out of any money in the treas-

ury not otherwise appropriated, the sum of five thousand dollars annually. This money shall be expended by the commissioners of said survey for the purpose of executing the duties assigned to them by chapter 297 of the laws of 1897, and any other duties which may be assigned to them by the legislature.

SECTION 2. This act shall take effect and be in force from and after its passage and publication.

Approved May 13, 1901.

#### CHAPTER 176, LAWS OF 1903.

An Act to appropriate money for the further prosecution of the geological and natural history survey of the state.

The people of the state of Wisconsin represented in senate and assembly do enact as follows:

**Appropriation of \$5,000 additional.** SECTION 1. There is hereby appropriated for the further prosecution of the geological and natural history survey of the state, out of any moneys in the treasury not otherwise appropriated, the sum of five thousand dollars annually, in addition to the sum now appropriated by law. This money shall be expended by the commissioners of said survey for the purpose of executing the duties assigned to them by chapter 297 of the laws of 1897, and any other duties which may be assigned to them by the legislature, and especially for the investigation of the clays and clay industries and the completion of the survey of the lead region.

SECTION 2. This act shall take effect and be in force from and after its passage and publication.

Approved May 6, 1903.

## PUBLICATIONS

OF THE

## Wisconsin Geological and Natural History Survey.

The publications of the Survey are issued as (1) bulletins, which are numbered consecutively, (2) biennial reports, and (3) hydrographic maps. These publications are independently paged and indexed, no attempt being made to group them in volumes.

## 1. BULLETINS.

The bulletins are issued in three series:

*Scientific Series.*—The bulletins so designated consist of original contributions to the geology and natural history of the state, which are of scientific interest rather than of economic importance.

*Economic Series.*—This series includes those bulletins whose interest is chiefly practical and economic.

*Educational Series.*—The bulletins of this series are primarily designed for use by teachers and in the schools.

The following bulletins have been issued:

*Bulletin No. I. Economic Series No. 1.*

On the Forestry Conditions of Northern Wisconsin. Filibert Roth, Special Agent, United States Department of Agriculture. 1893. Pp. vi, 78; 1 map. Out of print.

*Bulletin No. II. Scientific Series No. 1.*

On the Instincts and Habits of the Solitary Wasps. George W. Peckham and Elizabeth G. Peckham. 1898. Pp. iv, 241; 14 plates, of which 2 are colored; 2 figures in the text. Sold at the price of \$1.50 in paper and \$2.00 bound.

*Bulletin No. III. Scientific Series No. 2.*

A Contribution to the Geology of the Pre-Cambrian Igneous Rocks of the Fox River Valley, Wisconsin. Samuel Weidman, Ph. D., Assistant Geologist, Wisconsin Geological and Natural History Survey. 1898. Pp. iv, 63; 10 plates; 13 figures in the text. Out of print.

*Bulletin No. IV. Economic Series No. 2.*

On the Building and Ornamental Stones of Wisconsin. Ernest Robertson Buckley, Ph. D., Assistant Geologist Wisconsin Geological and Natural History Survey. 1898. Pp. xxvi, 544; 69 plates, of which 7 are colored, and 1 map; 4 figures in the text. Sent on receipt of 30 cents.



*Bulletin No. V. Educational Series No. 1.*

The Geography of the Region About Devil's Lake and the Dalles of the Wisconsin, with some notes on its surface geology. Rollin D. Salisbury, A. M., Professor of Geographic Geology, University of Chicago, and Wallace W. Atwood, B. S., Assistant in Geology, University of Chicago. 1900. Pp. x, 151; 38 plates; 47 figures in the text. Sent on receipt of 30 cents.

*Bulletin No. VI. Economic Series No. 3. Second Edition.*

Preliminary Report on the Copper-bearing Rocks of Douglas county, and parts of Washburn and Bayfield counties, Wisconsin. Ulysses Sherman Grant, Ph. D., Professor of Geology, Northwestern University. 1901. Pp. vi, 83; 13 plates. Sent on receipt of 10 cents.

*Bulletin No. VII. Economic Series No. 4.*

The Clays and Clay Industries of Wisconsin. Part I. Ernest Robertson Buckley, Ph. D., Geologist, Wisconsin Geological and Natural History Survey. 1901. Pp. xii, 304; 55 plates. Sent on receipt of 20 cents.

*Bulletin No. VIII. Educational Series No. 2.*

The Lakes of Southeastern Wisconsin. N. M. Fenneman, Ph. D., Professor of General and Geographic Geology, University of Wisconsin. 1902. Pp. xv, 178; 36 plates; 38 figures in the text. Out of print.

*Bulletin No. IX. Economic Series No. 5.*

Preliminary Report on the Lead and Zinc Deposits of Southwestern Wisconsin. Ulysses Sherman Grant, Ph. D., Professor of Geology, Northwestern University. 1903. Pp. viii, 103; 2 maps; 2 plates; 8 figures in the text. Out of print.

*Bulletin No. X. Economic Series No. 6.*

Highway Construction in Wisconsin. Ernest Robertson Buckley, Ph. D., State Geologist of Missouri, formerly Geologist, Wisconsin Geological and Natural History Survey. 1903. Pp. xvi, 339; 106 plates, including 26 maps of cities. Sent on receipt of 30 cents.

*Bulletin No. XI. Economic Series No. 7.*

Preliminary Report on the Soils and Agricultural Conditions of North Central Wisconsin. Samuel Weidman, Ph. D., Geologist, Wisconsin Geological and Natural History Survey. 1903. Pp. viii, 67; 10 plates, including soil map. Sent, paper bound, on receipt of 10 cents; cloth bound, 20 cents.

*Bulletin No. XII. Scientific Series No. 3.*

The Plankton of Lake Winnebago and Green Lake. C. Dwight Marsh, Ph. D., Professor of Biology, Ripon College. 1903. Pp. vi, 94; 22 plates. Sent, paper bound, on receipt of 10 cents; cloth bound, 25 cents.

*Bulletin No. XIII. Economic Series No. 8.*

The Baraboo Iron-bearing District of Wisconsin. Samuel Weidman, Ph. D., Geologist, Wisconsin Geological and Natural History Survey. 1904. Pp. x, 190; 23 plates, including geological map. Sent, paper bound, on receipt of 10 cents; cloth bound, 20 cents.

*In Preparation.*

The Geology of North Central Wisconsin. Samuel Weidman, Ph. D., Geologist, Wisconsin Geological and Natural History Survey.

The Lead and Zinc Deposits of Southwestern Wisconsin. Ulysses Sherman Grant, Ph. D., Professor of Geology, Northwestern University.

The Clays of Wisconsin. Heinrich Ries, Ph. D., Professor of Economic Geology, Cornell University.

## 2. BIENNIAL REPORTS.

The Survey has published three biennial reports, which relate to administrative affairs only and contain no scientific matter.

First Biennial Report of the Commissioners of the Geological and Natural History Survey. 1899. Pp. 31.

Second Biennial Report of the Commissioners of the Geological and Natural History Survey. 1901. Pp. 44.

Third Biennial Report of the Commissioners of the Geological and Natural History Survey. 1903. Pp. 35.

Fourth Biennial Report of the Commissioners of the Geological and Natural History Survey. 1904. Pp. .

## 3. HYDROGRAPHIC MAPS.

There have been prepared hydrographic maps of the principal lakes of southern and eastern Wisconsin. This work is in charge of L. S. Smith, C. E., Assistant Professor of Topographic and Geodetic Engineering, University of Wisconsin.

The maps are as follows:

		Size of Plate,	Scale, Inches	Contour In-
		Inches.	per mile.	terval, Feet.
No. 1.	Lake Geneva.....	17.5x10.8	2	10
No. 2.	Elkhart Lake.....	15.5x13.1	5	10
No. 3.	Lake Beulah.....	22.5x20.0	6	10
No. 4.	Oconomowoc-Waukesha Lakes.....	29.8x19.1	2	10
No. 5.	The Chain of Lakes, Waupaca.....	21.7x20.6	6	10
No. 6.	Delavan and Lauderdale Lakes.....	22.5x16.8	4	10
No. 7.	Green Lake.....	26.0x17.8	3 2	20
No. 8.	Lake Mendota.....	23.7x19.5	6	5
No. 9.	Big Cedar Lake.....	18.0x13.5	2.9	10
No. 10.	Lake Monona.....	17.6x17.3	4	5

In press:

- No. 11. Lake Kegonsa.  
No. 12. Lake Waubesa.

In all of these maps the depth of the lakes is indicated by contour lines, and by tints in all except No. 1. They are sent on receipt of 15 cents each, except Nos. 4 and 8, for which 20 cents are required. They may be had either mounted in a manilla cover, or unmounted.







